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A new moray eel, *Gymnothorax ryukyuensis*, from the Western Pacific Ocean (Anguilliformes: Muraenidae)

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琉球列島から得られたウツボ科魚類の１新種 (ウナギ目：ウツボ科)

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抄録：琉球列島より得られた標本に基づき，ウツボ属の１新種 *Gymnothorax ryukyuensis* を記載した．本種は，明色の体に，茶褐色の斑紋を持つこと，尾部の斑紋は大きなかたまりをつくること，臀鰭は淡色に縁取られること，生時，体全体が黄色の粘液を被ること，全脊椎骨数は133-137であることを特徴とする．インド・太平洋域に普通に分布する近似種の *G. flavimarginatus* とは，臀鰭全体にわたる淡色の縁を持つことにより区別される．

Abstract: A new moray eel, *Gymnothorax ryukyuensis*, is described from seven specimens from the Ryukyu Islands. It has light brown body, covered with small darker brown or black spots and blotches, anal fin with a pale edge, body with yellow mucus in life, and 133-137 vertebrae. It differs from *G. flavimarginatus*, its most similar species, by a pale edge of the entire anal fin..

Key Words: Muraenidae; new species; *Gymnothorax ryukyuensis*; Ryukyu Islands; Western Pacific

During the research of muraenid eels in Okinawa Island in 1980s, the author collected four specimens of beautiful moray eel with yellow mucus on the body. Though he convinced that this moray was an undescribed species and obviously included into *Gymnothorax*, the most specious genus in Muraenidae, he hesitated the description because the head or jaws teeth, which are very important part in the muraenid taxonomy, was destroyed by fisherman in most specimens. Recently an additional specimen identified to this species was collected from Kerama Islands, Ryukyu Islands in good condition and an under water photograph of this moray eel was demonstrated. Moreover in these twenty years the other additional two specimens were found out in the Kyoto University collection, then new species is described.

The methods of measurements follow those of Hatooka and Yoshino (1982). The count methods of predorsal and preanal vertebrae follow those of Böhlke (1982). The vertebral count of

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the holotype of *Gymnothorax flavimaruginatus* is from Böhlke and Smith (2002). Proportional measurements of type specimens of the new species are expressed as percentages of the total length (TL) or the head length (HL). Proportions and vertebral counts are given in Table 1.

Institutional abbreviations follow Leviton et al. (1985) except for KPM (Kanagawa Prefectural Museum of Natural History, Japan)

***Gymnothoax ryukyuensis* sp. nov.**

(New Japanese name: Ryukyu-utsubo)

(Figs. 1, 2 and 4, Tables 1 and 2)

Holotype. FAKU 51606, 840 mm TL, male, Umino Fisheries Port, Chinen, Okinawa Island, K. Hatooka, 4 Oct. 1982.

Paratypes. FAKU 41167, 755 mm TL, male, Ishigaki Island, Yaeyama Islands, H. Kojima, 14 Aug. 1967; FAKU 51436, 880 mm TL, male, Umino Fisheries Port, Chinen, Okinawa Island, K. Hatooka, 13 July 1982; FAKU 100235, 815 mm TL, female, Ankyaba, Kakeroma Island, Amami Islands, 2 July 1958; KPM-NI 008732, 951 mm TL, male, Kerama Islands, A. Ono, 11 January 2002; OMNH-P 11548, this specimen has been recently transferred from Seto Marine Biological Laboratory, Kyoto University (SMBL-F 73344) to Osaka Museum of Natural History, 906 mm TL, male, Yaeyama Islands, T. Yoshino, July 1973; OMNH-P 17950, this specimen has been recently transferred from Kyoto University (FAKU 51437) to Osaka Museum of Natural History, 938 mm TL, male, Umino Fisheries Port, Chinen, Okinawa Island, K. Hatooka, 12 July 1982.

Diagnosis. A larage and robust species of *Gymnothorax*. Dorsal fin moderately high, its origin before gill opening. Anus situated at mid body. Jaws teeth, sharp and strong in a single row. Body light brown, covered with small darker brown or black spots and blotches. Spots of tail forming ragged and obscure large blotches or obscure bars. Anal fin with broad pale edge. Skin with yellow mucus in life.

Description (data for holotype followed in parentheses by the mean and range of data for the holotype and paratypes). Anus at mid-body, the preanus length 1.98 (1.98; 1.90-2.04); head length 8.80 (8.49; 8.03-9.10); body elongate and compressed (Fig. 1), the depth at anus 15.4 (16.7; 15.3-19.6), all in TL. Eye diameter 11.7 (12.2; 11.2-13.1); interorbital width 6.68 (7.14; 6.62-8.06); snout moderately pointed, the length 5.75 (5.68; 5.16-6.16); mouth cleft length 2.03 (2.05; 1.92-2.21); predorsal length 1.02 (1.12; 1.02-1.24), all in HL. Dorsal fin height at anus 2.73 (2.22; 1.72-2.73) in body depth at anus. Predorsal vertebrae 5 (4.7; 4-5), preanal vertebrae 58 (58.3; 57-59), abdominal vertebrae 67 (67.3; 67-68), caudal vertebrae 67 (67.9; 65-70), total vertebrae 134 (135.1; 133-137).

Dorsal fin moderately high, its origin before gill opening and arising above 4-5th vertebra. Anal fin low, its origin just behind anus and below 57-59th vertebra. Gill opening nearly horizontal, its center slightly below mid-body, and its length somewhat longer than eye diameter.

Anterior nostril a short and slender tube on each side of tip of snout, not extending beyond edge of upper lip when depressed. Posterior nostril over front edge of eye, with a slightly raised

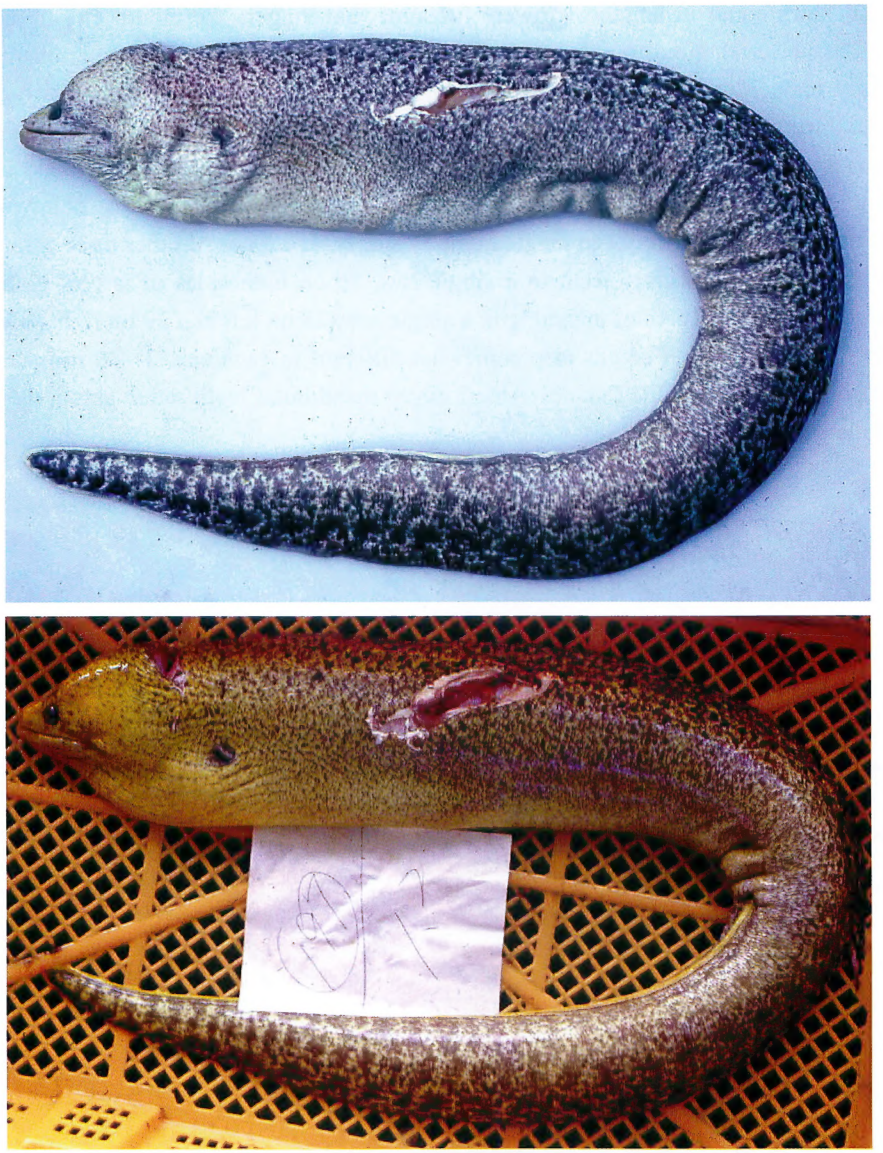

Fig. 1. *Gymnothorax ryukyuensis* sp. nov. Top, holotype preserved in alcohol, FAKU 51606, 840 mm TL, male, Umino Fisheries Port, Chinen, Okinawa Island; bottom, holotype in fresh.

rim.

Head pores very small but distinct (Fig. 2A). Supraorbital canal with three pores, one of which is situated anteroventrally to anterior nostril. Infraorbital canal with four pores (one paratype with additional one pore antero-dorsally to the ordinal situated second pore). Mandibular canal with six pores (three paratypes with 4, 5, 8 pores, respecitively). Two pores situated anterodorsally to gill opening.

Both jaws equal in length or lower jaw somewhat longer; the mouth closing completely. Teeth in jaws uniserial, stout, pointed and slightly retrorse (Fig. 2B). Teeth of peripheral series of premaxillary plate 12 (11-13 in male paratypes and 14 in the female; these counts include shed teeth); lateral teeth somewhat larger than anterior ones. Mesial part of premaxillary plate with three teeth, the posterior larger (four paratypes with three teeth, one paratype with two and one female with a single tooth). Prevomerine teeth minute and 2-13 in number, those of holotype and two paratypes in two rows anteriorly and single row posteriorly, and those of other three paratypes in an irregular single row. Maxillary teeth in a single row, 16 on both sides of jaw of holotype (five parataypes with 15-19). Teeth of mandible in a single row, 28 on left and 29 on right side of jaw of holotype. Mandibular tooth counts also somewhat different in each sex, 27-30 in males (include holotype) and 32-34 in a single female. Anteriormost mandibular teeth rather small, the second or third tooth largest.

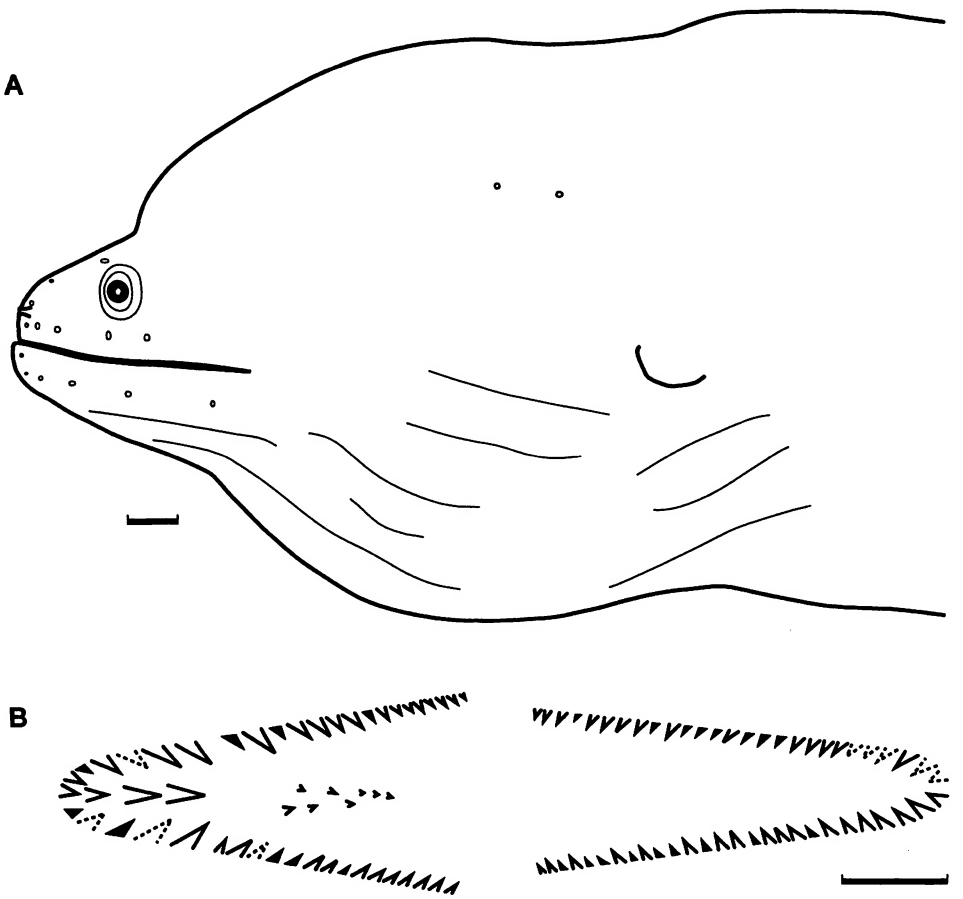

Fig. 2. *Gymnothorax ryukyuensis* sp. nov. A, head of holotype, FAKU 51606, 840 mm TL; B. dentition of holotype, dotted line teeth are broken ones and black are missing ones. Each scale indicates 10 mm.

Table 1. Proportions, vertebral counts and tooth counts of the holotype and 6 paratypes of *Gymnothorax ryukyuensis* sp. nov.

Cat.No.	Holotype	Paratypes					
	FAKU 51606 male	FAKU 41167 male	FAKU 51436* male	KPM-NI 100235 female	OMNH-P 8732 male	OMNH-P 11548 male	OMNH-P 17950 male
Total length (mm)	840	755	880	815	951	906	938
% of Total length							
Preanus length	50.4	48.9	50.9	49.7	52.6	50.0	50.7
Head length	11.4	12.5	12.0	11.9	11.9	11.0	12.0
Body depth (anus)	6.5	5.4	6.1	6.1	5.1	6.5	6.6
% of Head length							
Predorsal length	98.2	81.4	95.3	90.3	80.7	95.0	87.8
Mouth cleft length	49.2	46.1		52.2	48.9	51.1	45.3
Snout length	17.4	17.3		18.3	16.2	19.4	17.3
Eye diameter	8.6	7.9		8.9	8.0	7.6	8.4
Interorbital width	15.0	13.6		15.1	12.4	14.4	13.9
% of Body depth							
Dorsal height	36.6	45.2	53.9	58.2	38.1		45.9
Body width	70.5	91.4	72.7	70.0	69.1	64.2	68.8
Vertebral counts							
Predorsal vertebrae	5	4	5	4	5	5	5
Preanal vertebrae	58	57	58	59	59	58	59
Abdominal vertebrae	67	67	68	67	68	67	67
Caudal vertevrae	67	66	69	69	65	70	69
Total vertebrae	134	133	137	136	133	137	136
Tooth counts**							
Premaxillary							
peripheral series	12	11	?	14	13	12	12
medial series	3	3	3	1	3	3	2
Maxillary (left, right)	16,16	16,15	?,?	19,18	?,19	17,18	16,17
Mandible (left, right)	28,29	27,30	?,30	34,32	30,30	29,30	29,28

* head broken

** including shed tooth

Body light brown, covered with small darker brown or black spots and blotches, giving a mottled appearance. Spots of tail forming ragged and obscure large blotches or obscure bars. Fins with body coloring; a pale margin of posterior dorsal fin, continuing around caudal fin, onto anal fin; pale area of anal fin broader than dorsal fin. Head lighter than body, and with fewer and smaller dots; lower jaw rather whitish except one paratype with small faint dots; corner of mouth faintly dusky in holotype and that in other paratypes whitish; inside of mouth same color as lower jaws. Margin of gill opening in two paratypes blackish. Coloration in life similar to that in alcohol and skin of live or fresh specimen with yellow mucus.

Distribution. Ryukyu Islands, from Amami Islands to Yaeyama Islands.

Remarks. Characters presented in diagnosis demonstrates that the present species should be included in the genus *Gymnothorax*, based on the knowledge of many modern authors (Hatooka, 1984; Böhlke et al., 1989; Böhlke and Randall 2000).

Gymnothorax ryukyuensis is closely related to *G. flavimarginatus* (Rüppell, 1830), widely

Table 2. Comparisons of proportions and vertebral counts between *Gymnothorax ryukyuensis* and *G. flavimarginatus* (including holoype; data of vertebral counts of holotype from Böhlke and Smith [2002])

	G. ryukyuensis			*G. flavimarginatus*		
			aver.			aver.
Total length (mm)	755	- 951		143	- 1093	
% of Total length						
Preanus length	48.9	- 52.6	50.5	44.9	- 50.8	47.4
Head length	11	- 12.5	11.8	11	- 14.1	11.8
Body depth (anus)	5.1	- 6.6	6.0	4.6	- 7.9	5.8
% of Head length						
Predorsal length	80.7	- 98.2	89.8	80.1	- 105.5	90.9
Mouth cleft length	45.3	- 52.2	48.8	37.5	- 52.2	45.3
Snout length	16.2	- 19.4	17.7	15.5	- 21.2	18.1
Eye diameter	7.6	- 8.9	8.2	6.2	- 11.7	9.6
Interorbital width	12.4	- 15.1	14.1	12.1	- 16.5	14.7
% of Body depth						
Dorsal height	36.6	- 58.2	46.3	28.7	- 53.2	41.8
Body width	64.2	- 91.4	72.4	45.8	- 72.1	62.8
Vertebral counts						
Predorsal vertebrae	4	- 5	4.7	5	- 7	6.1
Preanal vertebrae	57	- 59	58.3	54	- 59	57.1
Abdominal vertebrae	67	- 68	67.3	65	- 67	66.4
Caudal vertevrae	65	- 70	67.9	67	- 70	68.6
Total vertebrae	133	- 137	135.1	133	- 136	134.6

Fig. 3. *Gymnothorax flavimarginatus,* FAKU 51568, 484 mm TL, Nishinohama Beach, Sesoko I., Okinawa Is.

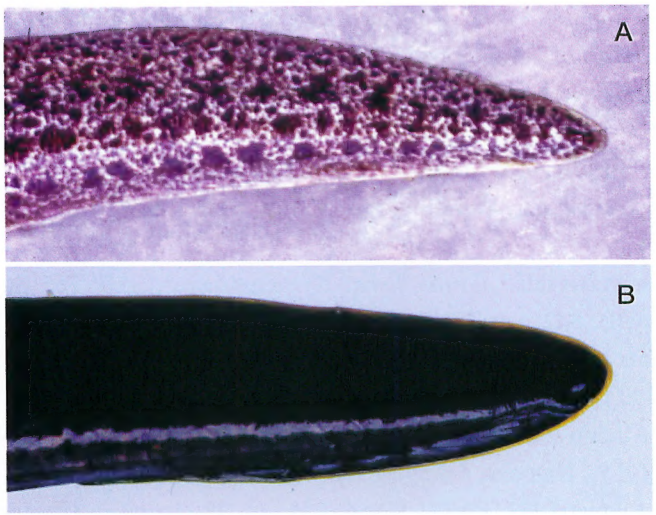

Fig. 4. Posterior part of tail of *Gymnothorax ryukyuensis* sp. nov. (A) , OMNH-P 17950, paratype, 938 mm TL and G. *flavimarginatus* (B), FAKU 51568, 484 mm TL.

distributed in Indo-West Pacific, in having nearly same body proportions and total vertebral counts and mottled colorations. *G. ryukyuensis* is, however, distinguished from *G. flavimarginatus* in having whitish lower jaw, gill opening without any marking (sometimes showing darkish appearance for its dark opening edge), large blotches in tail, anal fin with pale edge, and yellow mucus in life. In *G. flavimarginatus*, head and jaws are same coloration as body or darker; gill opening is in blackish blotches; though margin of anal fin has the same coloration, pale area is confined to posterior part of tail and sharply demarcated (not sharply in *G. ryukyuensis*) (Fig. 4). Though the position of origin of dorsal is not different externally between these two species, vertebral counts by soft X ray indicates a minor difference; vertebra opposite to origin of dorsal fin in *G. ryukyuensis* is 4-5th vertebra (5th in 5 of 7 specimens), while that in *G. flavimarginatus* is 5-7th (6th in 7 of 10 specimens).

Since Hatooka (1986) demonstrated sexual dimorphism in the number of jaw teeth, this difference has been found in some muraenid species (Hatooka and Randall, 1992; Böhlke, 1997a, b). The female of *G. ryukyuensis* seems also to have more mandibular teeth than the male (Table. 1). This difference was observed in only one available specimen and is a little obscure, but it agrees with sexual difference in mandibular teeth of some reported species (i.e. *G. ypsilon* Hatooka and Randall), suggesting that *G. ryukyuensis* also exhibits sexual dimorphism in jaw teeth.

Yellow mucus found in *G. ryukyuensis* (Fig. 1, bottom) is characteristic, though yellow color fades away soon after death and observed only in fresh condition. The author has observed this yellow coloration, maybe derived from mucus, in *Gymnothorax rueppelliae* (McClelland, 1844) and *Gymnothorax undulatus* (Lacepède, 1803). In these species, yellow coloration is confined to the top of head and yellow mucus on the whole body of *G. ryukyuensis* seems to be very unique in muraenid species. *Gymnothorax melatremus* Schultz, 1953 has also yellow body, but the author does not know whether this yellow color is derived from mucus or skin.

A moray eel reported from Kerama Islands as *Gymnothorax neglectus* in underwater photograph of Grand atlas of fish life modes by Masuda and Kobayashi (1994, p. 18, photo no. 4) is obviously *G. ryukyuensis*, judging from yellow color, white corner of mouth and light colored lower jaw.

Etymology. Species name is derived from its locality, the Ryukyu Islands, from Amami Island, south to Yaeyama Islands where the type series were collected.

Comparative materials. *Gymnothorax flavimarginatus*: SMF 765 (holotype of *Muraena flavimarginata* Rüppell), 542 mm TL, Red Sea; FAKU 31860, 31862-31866, 31868-31870, 144-370 mm TL, Hateruma I.,Yaeyama Is., 4-26 August 1960; FAKU 32292, 233 mm TL, Okinawa fish market, Okinawa I, Okinawa Is., 4-26 August 1960; FAKU 51344, 299 mm TL, Akagina, Amamiohshima I., Amami Is., 11 July 1958; FAKU 51407, 333 mm TL, Nishinohama Beach, Sesoko I., Okinawa Is., K. Hatooka, 6 August 1982; FAKU 51565, 729 mm TL, Sesoko I., Okinawa Is., K. Hatooka, 17 August 1982; FAKU 51566, 795 mm TL, between Iriomote I. and Kuroshima I.,Yaeyama Is., K. Hatooka, 11 September 1982; FAKU 51567, 670 mm TL, Barasu, off Uehara, Iriomote I., Yaeyama Is., K. Hatooka, 1 July 1982; FAKU 51568, 484 mm TL, Nishinohama Beach, Sesoko I., Okinawa Is., K. Hatooka, 9 August 1982; FAKU 51569, 466 mm TL, Sesoko I., Okinawa Is., K. Hatooka, 18 August 1982; FAKU 51570, 993 mm TL, between Iriomote I. and Kuroshima I., Yaeyama Is., K. Hatooka, 25 July 1980; FAKU 51571, 885 mm TL, Sesoko I., Okinawa Is., K. Hatooka, 15 August 1980; FAKU 51572, 1093 mm TL, Ishikawa, Okinawa I., Okinawa Is., K. Hatooka, 25 May 1982; FAKU 51573, 891 mm TL, between Iriomote I. and Aragusuku I., Yaeyama Is., S. Asato, June 1982; FAKU 51574, 823 mm TL, between Iriomote I. and Aragusuku I., Yaeyama Is., S. Asato, June 1982; FAKU 100232, 247 mm TL, Akagina, Amamiohshima I., Amami Is., 11 July 1958; FAKU 100233, 277 mm TL, Soumachi, Kikai I., Amami Is., 7 July 1958.

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